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Grass Energy

The Next Silver Bullet in Nova Scotia Agriculture?

In the early 1900s, the price of hay harvested from Nova Scotia extensive dykelands peaked at $28 per ton. Adjusted for inflation, today that price would be $572 per ton. This works out to $143 per 500 lb round bale or $14.30 per 50 lb square bale – several times what hay currently sells for in Nova Scotia.

The turn of the century hay market crashed a few years later as engines replaced horses as the main source of power and transportation. However, with rising oil prices and concerns over global climate change, there has been a renewed interest in converting hay into energy, the old “black gold” made new again. Does hay have the potential, as some proponents claim, to once again make hay producers rich?

When you scratch the surface of the issue, grass energy seems like a no-brainer for Nova Scotia. We have thousands of acres of under-utilized land and neglected pastures that could be used to grow hay. We have local inventors developing grass pellet furnaces and pelleting technology. We have farmers with hay-making equipment that is not being used to its full capacity. It looks like a recipe for success, and has certainly been getting some press lately: http://www.cbc.ca/news/canada/nova-scotia/story/2011/09/13/ns-grass-pellets-heat.html.

There are two main questions that should be answered before the province's agriculture industry embraces grass energy. First, is grass energy profitable at every stage in the value chain? Second, is grass energy really “green?”

Profitability

Many proponents of hay for energy tout that stemmy, old hay burns better than leafy, high-quality hay that would be fed to livestock. Furthermore, Nova Scotia's abundance of overgrown or abandoned hay fields and underused haymaking equipment seem like a good formula for cheap hay. Some grass energy proponents propose a price of $50 to $60 per ton, which would make grass pellets highly price-competitive with wood pellets. However, in order for farmers to get a decent return on their time, fuel, and equipment maintenance costs, there is a general consensus among farmers and farm extension workers that they must get a price of not less than $100/ton. For reference, farmers in the Truro area are currently getting $120 to $140/ton for good [feed?] hay. However, comparing revenue and expenses for feed hay and energy hay is not apples to apples. Let's break it out a bit further.

For good quality feed hay, farmers cut the field two to three times per season. To ensure good yield and quality, hay fields receive manure and/or chemical fertilizer. The species composition, cutting, and drying process are designed to ensure high leaf content, as most of the nutrition is in the leaves.

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For good quality energy hay, farmers cut the field once per season. They cut late to obtain as much leaf shatter as possible, thereby returning nutrients to the soil and reducing the amount of ash left after combustion. Letting the cut hay get rained on once or twice also helps to leach out nutrients, but the hay should be baled dry. For farmers used to crossing their fingers for three sunny days in a row each June to get a good first cut, cutting once and purposefully letting it get rained on seems almost too easy.

Bill Thomas, a forage specialist with AgraPoint, notes that the key factor that will determine if energy hay is profitable is yield. The main costs associated with making hay are the farmer's time and the equipment – both the purchasing and operating costs. If you already own the equipment, it doesn't cost much to cut and bale a few more acres of hay. At the same time, it doesn't take much more time to make an acre of hay at four tons per acre than at two tons per acre.

Thomas is evaluating the potential of purpose-grown energy crops that will provide higher yields than overgrown hay fields. A crop should ideally grow well on poorer land, so as not to compete with food crops, and require few inputs. It should also return nutrients to the soil before harvest through weathering.

Switchgrass has been heavily promoted as an energy crop but it is not delivering on its yield promise in Nova Scotia. Reed canary grass is another candidate crop but it has a high stem:leaf ratio so there's not much biomass left after weathering. Thomas is currently looking into a promising new crop called Miscanthus, which can produce up to 20 tons per acre in the southern US. Two challenges with the adoption of Miscanthus are that it is propagated by rhizome rather than by seed, which would increase field establishment costs, and it would need to be harvested with a corn chopper rather than a haybine.

Other costs in the hay energy value chain include the cost of pelleting, transportation and storage. Given the newness of grass burning technology, these additional costs mean that grass pellets may not yet be competitive compared to fossil fuels for home heating. For on-farm heating, however, hay energy looks quite attractive.

A recent workshop held at the Nova Scotia Agricultural College and co-sponsored by the Ecology Action Centre examined the technical feasibility of agricultural biomass for energy production, primarily heat. Tim Ansems, a poultry farmer from Kings County, shared his decision to import a round straw bale furnace for use with his new turkey barn as an alternative to propane heat. Despite the paperwork and expense involved in purchasing the straw furnace from the UK, his heating costs per turkey flock have halved compared to the propane furnace. The straw furnace is on track to pay for itself in seven to ten years.

Denmark is one of the world leaders in the use of agricultural biomass for fuel. Anders Evald of FORCE Technology in Denmark gave a good overview of the Danish experience at the workshop. In particular, he noted that the market for agricultural biomass, which is mainly straw in Denmark, began first with farmers using it for their own heating needs, then with district heating plants, and finally by combined heat and power plants. Straw is also sometimes purchased by large power plants for electricity production.

This growth strategy was echoed by other workshop participants. Farmers should begin looking at grass energy primarily as a solution to their own heating needs. Once the technology and processes have been established on farms, commercial and residential heating markets may emerge.

How can a farmer determine how many pellets s/he needs to replace current oil or propane for a greenhouse or livestock barn? To give an example, a farm energy audit for a Kings County greenhouse grower recommended replacing the greenhouse's oil furnace with a wood pellet furnace and oil furnace back-up. The new furnace was projected to pay for itself in fuel savings in 6.1 years. The audit calculated that one tonne of wood pellets would replace 509 litres of furnace oil. Since grass pellets provide about 10% less heat than wood pellets by weight, one tonne of grass pellets would replace 458 litres of furnace oil. This figure might be different for different-sized greenhouses and barns. For more information on evaluating your energy consumption and looking for ways to reduce energy costs, contact Julie Bailey, the provincial farm energy specialist at baileyja@gov.ns.ca.

So the answer to the question of the profitability of grass energy is that the potential is definitely there, especially for on-farm heating. Farmers must be careful, however, to assign a value for hay that truly covers their costs and also remember that their primary competitor is not wood, but fossil fuels.

Environmental Considerations

So what about the second question, is grass energy really "green?"

On the surface this seems like a no-brainer. The grass converts the sun's energy into biomass and we convert that into heat. But a lot of energy goes into making hay, such as fertilizer for the crop and diesel for the tractor. If the hay is pelleted, you need either electricity or diesel for a generator to run the pellet machine. Finally, the combustion process creates emissions in the smoke.

On this topic, the evidence seems more straightforward. While detailed life cycle assessments in Nova Scotia have not yet been completed, research on other crops and in other jurisdictions suggest that the net benefit compared to fossil fuels is substantial. For example, Resource Efficient Agricultural Production Canada states on their website that grass pellets emit only 8.2 kg of CO2/GJ of heat, compared to 93.1 kg CO2/GJ for coal (www.reap-canada.com/bio_and_climate_3_2.htm).

Besides greenhouse gas emissions, a key environmental and social concern in many parts of the world is that land currently used to produce food crops will instead be devoted to fuel crops. In Nova Scotia, with its abundance of under-utilized land suitable for growing perennial forage crops, this concern is currently unwarranted although it's certainly something to continue to monitor.

A related concern is that using agricultural biomass for fuel will lead to soil degradation. Again, while this is an important concern that needs to be monitored, letting the forage crop get rained on before baling returns nutrients and leaf trash to the soil, so nutrient removal is not as much of an issue as with cereal crops or even feed-quality hay.

Regarding air emissions, grass-based biomass does not generally seem to be a major source of harmful emissions. The primary concerns are with chlorine and sulphur dioxide, which hay pellets have in greater quantities than wood pellets. Christina Campbell from the Air Quality Division of the Nova Scotia Department of Environment spoke at the biomass workshop last fall. She said that research to evaluate risk from emissions is ongoing. Because emissions vary depending on the grass species or mixture, the age of the grass when it was cut, how wet it was baled, and other factors, there is no one size fits all solution. Three key factors are furnaces that are properly designed and maintained to reach the optimum combustion temperature, scrubbers on the furnace to remove certain emissions, and allowing the biomass to weather (i.e. get rained on) to leach some of the substances back into the soil.

So is it "all systems go" for grass energy? The way forward seems to be clear: if the biomass industry is to be developed in a sustainable way, it must be built up relatively slowly and primarily by farmers for their own use. Farmers must take care to properly assess their costs and be sensitive to the social and environmental concerns that exist around the use of grass energy in order to ensure the long-term sustainability of the industry.

For more information, visit the Farm Energy Nova Scotia website: www.nsac.ca/fens

Or contact provincial Farm Energy Specialist Julie Bailey at baileyja@gov.ns.ca